1st MINERVA SERVICE MANUAL

SOPRASsub

www.soprassub.com

2.0 SPECIFICATIONS

SOPRASsub Minerva

AIR FLOW ..... 33 cu. ft. (935 liters/min). @ 1 atmosphere
INHALATION RESISTANCE .. 0.9" -2.0" (2.3 - 5.08 cm) w.c. @ 1 atmosphere
EXHALATION RESISTANCE .. 0.6" (1.52 cm) w.c. max. @ 1 atm.

RECOMMENDED LUBRICANT LTI Christo-Lube MCG 111®

A. SOPRASsub FIRST STAGE REGULATOR
TYPE ..... balanced Piston Regulator - swivel
WEIGHT ..... YOKE--(0.88 KG) DIN—(0.70 KG)
INTERSTAGE PRESSURE ..... 135-145 psi (9.4-10 bar)
@ 3000 psi inlet (207 bar)
 # LOW PRESSURE PORTS .... 5 (3/8"-24 UNF)
 # HIGH PRESSURE PORTS ... 2 (7/16"-20 UNF)
MATERIALS ..... Body -------- CDA-360 Brass
O-rings ----- Buna-N
Seat --------- TEFLON

2.1 Torque Specifications:

Description	Item #	Torque
CAP	17	120-140 in/lbs (13.56-15.82 N.M)
DIN HOUSING	28	16-18 ft/lb (21.70-24.41 N.M)
YOKE RETAINER	3	23-25 ft/lb (31.19-33.90 N.M)
DIN RETAINER	31	120-130 In/lb (13.56-14.69 N.M)
SEAT CAP SCREW	27	120-140 in/lbs (13.56-15.82 N.M)
SWIVEL RETAINER	15	120-140 in/lbs (13.56-15.82 N.M)
PORT PLUGS	21, 23	35-40 In/lbs (3.96-4.52 N.M)
Hose inlet end		2-3 ft/lb (3-4 Nm)
Hose outlet end		2-3 ft/lb (3-4 Nm)

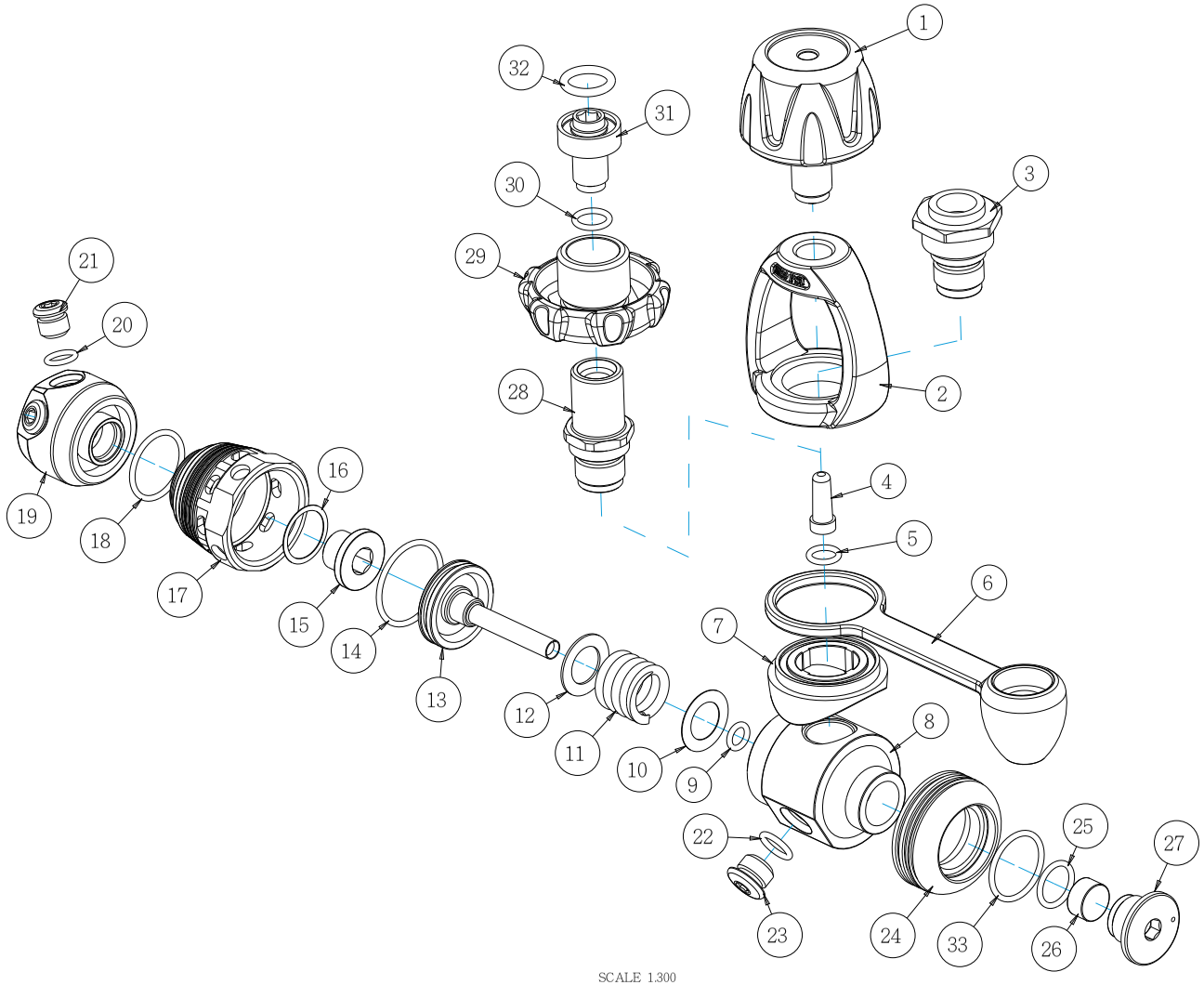
3.0 SERVICE KIT LIST

Minerva FIRST STAGE SERVICE KIT			
NO	PART NO	DESCRIPTION	Q'TY
4	0113	FILTER	1
5	2- 011-02	O-RING	1
9	2- 010-02	O-RING	1
14	2- 022-01	O-RING	1
18	2- 019-01	O-RING	1
20	3- 903-01	O-RING	4
22	3- 904-01	O-RING	2
25	2- 014-02	O-RING	1
26	0140	HP SEAT	1
30	2- 012-02	O-RING	1
32	2- 112-02	O-RING	1
33	2- 019-01	O-RING	1

REVISION				
LTR	DESCRIPTION	DATE	APPR	ECN NO
A	RELEASE	2010/04/13		

SOPRAS

AS-103 PISTON BALANCED REG PART LIST			
NO	ITEM NO	DESCRIPTION	Q'TY
1	0111	YOKE KNOB ASSEMBLY	1
2	0055	3500 PSI YOKE	1
3	0133	YOKE RETAINER	1
4	0113	FILTER	1
5	2-011-02	011 O-RING N90	1
6	0118	DUST CAP	1
7	0132	SADDLE	1
8	0134	MAIN HOUSING	1
9	2-010-02	010 O-RING N90	1
10	0131-01	WASHER - THINNER	1
11	0135	MAIN SPRING	1
12	0131-02	WASHER - THICKER	1
13	0136	PISTON	1
14	2-022-01	022 O-RING N70	1
15	0137	SWIVEL RETAINER	1
16	0143	SWIVEL WASHER	1
17	0138	CAP	1
18	2-019-01	019 O-RING N70	1
19	0139	LP PORT SWIVEL	1
20	3-903-01	903 O-RING N70	4
21	0109	LP PIUG	4
22	3-904-01	904 O-RING N70	2
23	0108	HP PLUG	2
24	0142	STYLE CAP	1
25	2-014-02	014 O-RING N90	1
26	0140	HP SEAT	1
27	0141	HP SEAT CAP	1
28	0114	DIN HOUSING	1
29	0116	DIN WHEEL KNOB ASSEMBLY	1
30	2-012-02	012 O-RING N90	1
31	0115	DIN RETAINER	1
32	2-112-02	112 O-RING N90	1
33	2-019-01	019 O-RING N70	1



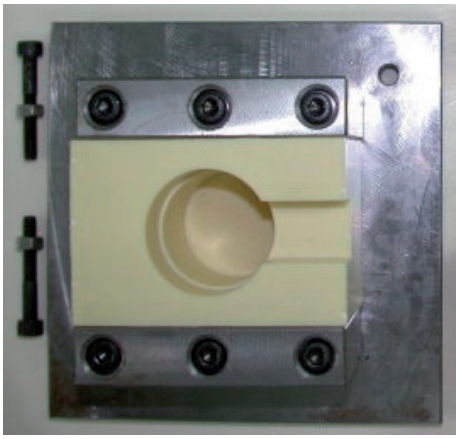
SCALE 1.300

MINERVA PISTON BALANCED REGULATOR FIRST STAGE

DO NOT SCALE THIS DRAWING UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MM TOLERANCES ANGLES # ± X # .1 XX # .05 FRACTION # 1/64	*AS DESIGN CENTER*		
	TITLE MINERVA PISTON BALANCED REGULATOR		
FINISH: SEE NOTES	SIZE B	USED ON	DRAWING NO. AS-103
	REV A		
	SCALE 0.313	FILENAME	SHEET 1 OF 1

3.1 SERVICE TOOL LIST

TORQUE WRENCH



FIXTURE HOLDLE AND
FIXTURE BLOCK

1.7MM DRILL BIT

5/16” HEX BIT SOCKET

O-RING TOOL SET

1” HEX DEEP SOCKET

1/4” HEX BIT SOCKET

4MM HEX BIT SOCKET

13/16” HEX DEEP SOCKET

INSTALL TOOL

PIN SPANNER WRENCH

STAINLESS HANDLE BAR

TORSION BAR

YOKE-RETAINER WRENCH

4.0 SERVICE PROCEDURES FOR THE SOPRASsub Minerva SERIAL

4.0.1

Before you begin disassembly of the regulator, test the first and second stages for output pressures and leakage. Pre-testing in this way will help the technician to pinpoint any specific problems requiring repair.

4.0.2

The work area must be clean and well lighted, with clean compressed air available to blow sand and dirt from parts.

4.1 TOOLS AND PARTS LIST REQUIRED FOR SOPRASsub SERVICING

- Fixture block (supply from SOPRASsub) OR Soft-jawed bench vise (bench vise with rubber, plastic, aluminum or plastic jaw inserts)
- PIN SPANNER AND HOLD SOCKET FOR END CAP (17)
- 1" HEX SOCKET FOR YOKE RETAINER (3)
- 4MM HEX BIT SOCKET FOR PORT PLUG (21, 23)
- 1.70MM DRILL BIT FOR HP SEAT (26)
- 13/16" HEX DEEP SOCKET FOR DIN HOUSING (28)
- 1/4" HEX BIT SOCKET FOR DIN RETAINER (31), SEAT CAP SCREW (27)
- 5/16" HEX BIT SOCKET FOR SWIVEL RETAINER (15)
- 5~25N.M - 3/8" TORQUE WRENCH ADJUSTABLE
- 19~110N.M - 3/8" TORQUE WRENCH ADJUSTABLE
- STAINLESS HANDLE BAR
- 1st STAGE ANNUAL SERVICE KIT
- CLEAN SHOP RAGS
- LTI Christo-Lube MCG 129®, or Dow-Corning 111® Silicone Grease
- Intermediate Pressure Testing Gauge

4.2 DISASSEMBLY OF THE SOPRASsub FIRST STAGE FOR OVERHAUL

To view all of the parts used in the SOPRASsub first stage, look at the inside front cover of this manual. The bracketed numbers in the text refer to the corresponding circled item numbers on the exploded view drawing.

4.2.1

Use the 6” and 8” adjustable wrenches to loosen the hose nut from the PORT of 1st stage. Remove the hose assembly from the second stage. Inspect the hose assembly for any cuts or cracks, especially on the hose at the metal ferrules. Blow the interior bores of the hoses.

Replace the hose assembly if any cuts or cracks are found. Remove and discard the O-rings from each end of the hose. Clean, rinse, and blow-dry the interior bores of the hoses. Replace the hoses if necessary.

Note:

Hose Protectors are easier to slide back from the 1st stage end of the hose if they are twisted and pulled when the hose is still installed in the 1st stage. If a hose protector is particularly difficult to pull back, try removing the hose and soaking the hose protector end in hot water to soften it up. Temporarily reinstall the hose and try pulling and twisting the hose protector again.

4.2.2

Put the body into the fixture block or clamp carefully in a soft-jawed bench vise. Remove the yoke knob assembly (1) from the yoke (2). Use 1" HEX SOCKET to loosen and remove the yoke retainer (3), the dust cap (6) and saddle (7).

Note:

If the regulator has a DIN wheel, use a 1/4" HEX BIT SOCKET to remove the DIN retainer (31) and DIN wheel (29), use a 13/16" HEX DEEP SOCKET to remove the Din housing (28).

4.2.3

Remove the inlet filter (4), the filter O-ring (5) and Din retainer o-ring (30) if the regulator is DIN equipped. Discard all o-ring.

4.2.4

Use a 4MM HEX BIT SOCKET to remove all port plugs (21, 23) from the body. Discard the port plug O-rings. (20, 22)

4.2.5

STAINLESS HANDLE BAR screw in hp port. Put the body into the fixture block or on the table. Use the PIN SPANNER to remove the Cap (17) from the Body (8). Remove any Spacer(s) (10, 12), the Spring (11) and the Piston (13) from the Cap.

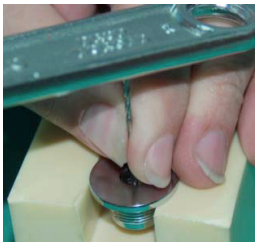
Remove and discard the O-rings (14) from the piston. Remove and discard the O-rings (9) from the body. Whenever possible, try to remove the O-rings by pinching them with the fingers and rolling them out of the groove.

! WARNING !

If a sharp pick is used to remove the O-rings, it should be made from soft brass, not steel. ANY scratches left in the groove when removing O-rings will cause leaks (bubbling out of the Cap ambient pressure ports) and the piston will have to be replaced to stop these leaks.

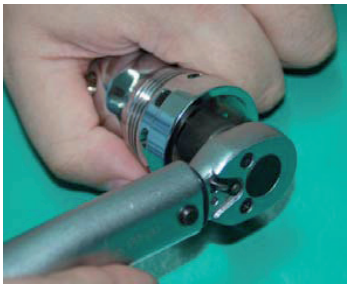
4.2.6

Put the body into the fixture block again with the hp seat cap (27) facing up. Use a 1/4" HEX BIT SOCKET to remove the seat cap (27). Remove the o-ring (25) from the body (8). Remove the o-ring (33) and style cap (24). Remove the Seat (26) from the seat cap (27) by pushing it out with a 1.70MM DRILL BIT. Place one end of the drill bit on a flat hard surface. Lower the large end of the seat cap over the drill bit until the flat end of the drill bit rests against the back side of the Seat. Push the seat cap firmly down straight on the drill bit, until the seat is pushed out of the seat cap. Discard the old Seat.



4.2.7

STAINLESS HANDLE BAR screw in LP port swivel. Use a 5/16" HEX BIT SOCKET to remove the swivel retainer (15) and swivel washer (16) . Remove and discard the o-ring (18) from the cap (17).



4.3 Cleaning and Inspection of the 1st Stage

4.3.1

Clean all metal parts of the first stage in an ultrasonic cleaner or cleaning solution. See Section 5.3 for recommendations on cleaning solutions. Remove the O-rings before cleaning any metal parts since the soft O-ring material will absorb cleaning energy from the ultrasonic cleaner reducing its effectiveness. If major visible corrosion or deposits exist on parts, use a bristle brush, wooden, or plastic stick to rub the deposits off. Allowing acidic cleaning solutions to do all of the work, if deposits are severe will result in damage to internal chrome plating which will make parts even more susceptible to future corrosion.

4.3.2

Remove the regulator parts from the cleaning solution. Rinse with clean fresh water, then blow internal passageways dry with clean, dry compressed air.

4.3.3

Inspect all O-ring grooves for scratches or wear. If the regulator was leaking air because of scratches or wear, replace the parts. If some corrosion deposits persist, carefully wipe them away with a plastic scrubbing cloth or plastic or wooden dowel. Blow any resulting dust out of the regulator parts.

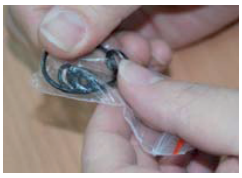
4.3.4

Closely examine the sealing cones (orifices) in the piston (13) where the Seat (26) of the Piston seal.

4.4 PRELIMINARY ASSEMBLY OF THE FIRST STAGE

4.4.1

To determine the identity of each O-ring in the Service Kit, remove them from the bag and use the O-ring Identification Chart on the front page of this manual. Lay each O-ring over its corresponding picture on the page and read the description. Before installing new O-rings into the regulator, lightly lubricate the O-rings with LTI Christo – Lube MCG 129 (for enriched air regulators), or Dow-Corning 111 silicone grease. The most effective way to lubricate the kit O-rings is to put them in a small plastic bag with a pea sized amount of grease. Rub the O-rings and grease together in the bag until all the O-rings are coated evenly. Try not to wipe the lubrication off the O-rings when assembling them onto other parts.



4.4.2

Place the hp Seat (26) on a clean flat surface and press the seat cap (27) stem straight over the seat until the new seat is installed into the end of the Piston.

4.4.3

Install the pre-lubricated (see 4.4.1) O-rings (14) onto the piston, O-ring (9) onto the body (8) and o-ring (18) onto the cap (17).

Put the swivel washer on the place of the cap (17) and insert the swivel retainer (15) into the cap (17) and then screw to the LP swivel with the cap assembly. Tighten the swivel retainer (15) with a 5/16" HEX BIT SOCKET, follow the Torque Specifications.

4.4.4

Carefully guide the large end of the Piston into the Cap until it bottoms. Use a gentle rocking motion if necessary to move the Piston into the Cap, but do not cock it at too severe an angle since this may cause the Piston to gouge the sealing surface of the Cap.

4.4.5

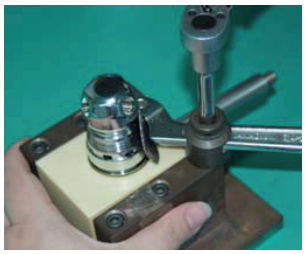
Support the Body (8) so that the Cap threaded end is facing up. Use the same number of Shims (12, 10) that were installed in the Spring Cavity when you took the Minerva serial apart. If there was one shim, it goes on the Body side of the SPRING (11). If there were two Shims, install one at each end of the SPRING. Install the SPRING (11) on top of the Shim.

4.4.6

Lubricate the threads on the Cap (17) with grease. Put the Cap with its Piston (13) installed over the Spring and Shim sitting in the cavity of the body and screw them together as far as you can by hand. Use the install tool can be put the piston into the body more easily.
(see the photo)

4.4.7

STAINLESS HANDLE BAR screw in hp port. Put the body into the fixture block or on the table. Use PIN SPANNER to snug the Cap (17) onto the body with 120-140 in/lbs (13.56-15.82 N.M) of torque



4.4.8

Put the style cap (24) into the body (8). Install the pre-lubricated(see 4.4.1) O-rings(33) onto the style cap and o-ring (25) onto the body. Screw the seat cap assembly to the body. Tighten the hp seat cap (27) with a 1/4" HEX BIT SOCKET, follow the Torque Specifications.

4.4.9

Install the yoke retainer (3) into the yoke (2). Install the saddle (7) onto the yoke.

4.4.10

Install the new inlet filter (4) and filter O-ring (5) into the yoke retainer (3).

4.4.11

Hand tighten the yoke, yoke retainer into the body.

Note:

If the regulator has a DIN connection, Install the new filter (4) and filter O-ring (5) into the DIN housing (28).

Hand tighten the DIN housing (28) into the body

4.4.12

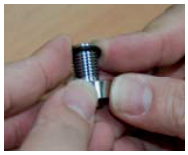
Place the body carefully into a fixture so that the yoke retainer or DIN housing is facing up.

4.4.13

Tighten the yoke retainer (3) or the DIN housing (28) with a 1" HEX SOCKET or 13/16" HEX DEEP SOCKET. Tighten yoke retainer to 23-25 ft/lb (31.19-33.90 N.M). Tighten din housing to 16-18 ft/lb (21.70-24.41 N.M).

4.4.14

Install the new O-rings (30, 32) into Din retainer (31)



4.4.15

Install the DIN wheel (29) into din housing (21) and hand tighten the din retainer (31)into the din housing.

4.4.16

Tighten the din retainer with 1/4" HEX BIT SOCKET. Tighten din retainer (31) to 120-130 In/lb (13.56-14.69 N.M).

4.4.17

Install new O-rings (20, 22) from the kit onto port plugs (21, 23) and install the port plugs into the appropriate ports. Use the 4MM HEX BIT SOCKET to tighten port plugs to 35-40 In/lbs (3.96-4.52 N.M).

4.4.18

Install the dust cap (6) and yoke knob (1) onto the yoke.

4.5 SET-UP AND TESTING THE FIRST STAGE

Note:

The Minerva serial regulator has a BALANCE piston 1st stage. For safety, test the first stage regulator with at least one second stage installed. The demand valve on the second stage acts as a relief valve in case of a malfunction.

4.5.1

Install an intermediate pressure test gauge into one of the low-pressure ports of the first stage, and a functional 2nd stage into another low pressure port. Plug any remaining open outlet ports with suitable port plugs.
Attach the regulator to a tank valve giving a source pressure of between 2700 and 3000 psig (186-210 Bar).

NOTE:

The following test determines the regulator's lock-up pressure (the pressure put out by the first stage during a no flow condition).

4.5.2

Turn the air tank ON by SLOWLY while listening for any unusual air leaks. If any are heard, turn the air off immediately and determine the source of the leak. If no leaks are found, watch the intermediate pressure gauge reading rise as you continue turning the air on slowly. It should stop before 150 psi (10.2 bar).

4.5.3

If the pressure gauge continues to rise above 150 psi (10.2 bar), turn the air supply off immediately and inspect the regulator to determine the cause.

4.5.4

Depress the 2nd stage purge cover fully, then release it several times to clear particles from the regulator, and to work the internal parts into place. To prevent uncontrolled free flows after pushing the purge cover, keep the deflator knob on the second stage in the "-" (negative position).

4.5.5

The pressure range for Minerva serial Regulators at 3000 psi inlet pressure is 130-150 psi (9-10.2 bar). Add Shims in either side of the spring to raise the intermediate pressure. Remove Shims to lower the pressure. The pressure increase per shim is not linear due to the rate of the spring, so no specific increase per spring can be given. Generally, only add a shim if the intermediate pressure (when the cylinder pressure is 3000 psi) is below the 130-145 (9-10.2 bar) range. Adding just one shim under these conditions will not push the intermediate pressure above the maximum 150 pressure. Do not aim for a specific pressure within the range, just add or remove shims to get the pressure within the range. The optimal intermediate pressure for Minerva serial regulators is 140 psi (10 bar), but any setting between 130 and 150 psi (9-10.2bar) at 3000 psi (207 bar) inlet pressure will provide good stable performance.

4.5.6

After reaching the proper pressure setting, push the purge cover on the second stage again several times and watch how the intermediate pressure reading responds. When the purge cover on the second stage is depressed, the intermediate pressure reading will drop. When the purge cover is released the pressure should return immediately to the proper lock-up pressure and stay there.

4.5.7

Let the regulator sit with the tank valve turned on for several minutes. The intermediate pressure reading may rise about 3 psi in the first three seconds after lock-up, but after that it should not rise more than another 4 psi (.3 bar) in five minutes. If it rises more than 4 psi refer to the Trouble-shooting Section 5.1 of this manual.

Note:

Never set the output pressure of the first stage above 150 psig (10.2 bar).

5.0 HELPFUL HINTS

5.1 TROUBLESHOOTING

POSSIBLE CAUSE	RECOMMENDED ACTION
Inlet filter clogged.	Replace the filter.
Air supply to 1st stage insufficient.	Verify the supply air pressure. Make sure the customer had the air valve turned all the way on during the dive.
1st improperly adjusted.	Refer to sections 4.5 of this manual.

A. CREEPING INTERMEDIATE PRESSURE:

POSSIBLE CAUSE	RECOMMENDED ACTION
Damaged or worn 1st stage seat (26).	Replace seat
Nick in sealing surface of PISTON (13)	Replace Body or Buff out Scratch
Seat (26) has not taken shape of PISTON yet.	Let the Regulator sit with the pressure on for a few minutes and measure pressure again.

B. HIGH FREQUENCY HUMMING OR BUZZING DURING INHALATION:

POSSIBLE CAUSE	RECOMMENDED ACTION
Harmonic resonance between the springs and other 1st stage components.	Remove the main spring (11) flip it over and re-install.
	Replace spring or other components until resonance stops.